Citation:

Zizza CA, Tayie FA, Lino M. Benefits of snacking in older Americans. *J Am Diet Assoc.* 2007; 107: 800-806.

PubMed ID: 17467375

Study Design:

Cross-Sectional Study

Class:

D - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To evaluate the influence of snacking on energy intake and energy density in older adults.

Inclusion Criteria:

- Participation in the National Health and Nutrition Examination Survey (NHANES) in 1999 to 2002
- Age 65 years or more at time of interview
- No missing data for any of the variables was used in the study
- The Auburn University Institutional Review Board classified the research as exempt.

Exclusion Criteria:

- Age less than 65 years
- Non-participation in NHANES
- Missing data for any of the variables used in the study.

Description of Study Protocol:

Recruitment

The study is secondary data analysis and did not describe the original NHANES recruitment procedures.

Design

- NHANES is nationally representative of the US and contains over-samples of Mexican Americans, African Americans, low-income whites, adolescents age 12 to 19 and adults age 60 years and older

- Participants completed a household interview, physical examination and dietary recall interview.

Dietary Intake/Dietary Assessment Methodology

Automated, face-to-face 24-hour dietary recalls were used. The interviews included probes for eating occasions and amounts consumed.

Statistical Analysis

- Analyses incorporated survey design variables for appropriate weighting and variance estimation
- Significance was set at $P<0.05$.
- Non-snackers and snackers were compared on demographic characteristics via chi-square tests
- Linear regression models controlling for the demographic characteristics were used to estimate the number of total eating and snacking occasions, total energy per eating occasion and energy density per eating occasion.

Data Collection Summary:

Timing of Measurements

The design was cross-sectional. Subjects completed a 24-hour dietary recall interview as part of NHANES in 1999 to 2002.

Dependent Variables

- Energy (kcal)
- Protein (g)
- Carbohydrate (g)
- Total fat (g)
- Saturated fat (g)
- Alcohol (g)
- Number of snacking and meal occasions
- Calories per eating occasion
- Calories per gram consumed by eating occasion.

Independent Variables

Snacking status (non-snacker, snacker): Snacking occasions included both snacks and beverages, per the NHANES definitions.

Control Variables

- Age (65 to 74, 75 to 84, 85 years or more)
- Poverty income ratio (zero to 1.85, 1.86 to 3.50, more than 3.50): Ratio of family income to the Census Bureau-defined poverty threshold; the categories were set based on eligibility criteria for several federal programs
- Sex
- Ethnicity (Hispanic, non-Hispanic white, non-Hispanic African American): To form larger analysis categories, Mexican Americans and other Hispanics were combined, and "Other" race was combined with non-Hispanic whites

- Education (less than high school degree, high school degree or more)
- Marital status (married or living with partner, single, widowed, separated, never married)
- Smoking status (never, former, current): Respondents were asked if they had ever smoked 100 or more cigarettes, 20 or more pipes or 20 or more cigars; never smokers answered no to all three questions.

Description of Actual Data Sample:

- *Final N:* 2,002 (38% male)
- *Age:*
  - 67% were age 65 to 74 years
  - 27% were age 75 to 84 years
  - 6% were age 85 years or more
- *Ethnicity:* 8% Hispanic, 84% non-Hispanic white, 8% non-Hispanic African American
- *Other relevant demographics:*
  - 71% had at least a high school diploma
  - 57% were married
  - 50% had never smoked, 12% were current smokers and 38% were former smokers
- *Location:* United States.

Summary of Results:

- 84% of adults 65 years or older were snackers. Snackers were more likely to be white and have a higher income (P<0.05).
- Snackers had significantly higher intakes of energy and macronutrients (P<0.05), except alcohol, compared to non-snackers
- Snackers had significantly more eating occasions and higher energy density per eating occasion (P<0.05) than non-snackers

	Non-snacker (N=359)	Snacker (N=1,643)
Nutrient (mean ± SE)		
Energy (kcal)	1,466.0±65.4	1,717.9±48.4
Protein (g)	61.3±2.3	65.7±2.4
Carbohydrate (g)	182.5±9.2	223.4±6.0
Total fat (g)	54.8±3.5	63.6±3.1
Saturated fat (g)	15.7±1.1	19.0±0.8
Alcohol (g)	5.1±2.3	4.9±1.7
Eating occasions (mean ± SE)		
Total eating occasions	3.50±0.12	5.45±0.13
Total snacking occasions	0	2.54±0.13
Energy per meal occasion	460.0±17.6	446.0±12.5
Energy per snacking occasion	0	150.0±10.0
Snacking energy density (kcal per g)	Not applicable	1.35±0.09

Meal energy density (kcal per g)	0.84±0.04	0.89±0.02

Estimates were adjusted for age, income, sex, race/ethnicity, education, marital status, and smoking status.

Other Findings

Snacks contributed the following percentages of total daily intakes to snackers' diets: 23% calories, 14% protein, 26% carbohydrate, 20% fat, 12% alcohol.

Author Conclusion:

- In a nationally representative sample of older adults, snacking is an important behavior, given its high prevalence and significant energy contribution. Findings were similar to other published studies among this age group.
- Although snacking may promote weight gain in other age groups, it may ensure that older adults consume adequate energy and macronutrients. Snacks were a significant source of fat and carbohydrate, but they also provided a 14% of snackers' protein intake, suggesting snacks were not merely empty calories.
- Since the energy contribution of meals was similar between snackers and non-snackers, promoting healthy snacks may help to increase older adults' energy and nutrient intakes.

Reviewer Comments:

- *Author identified limitations: NHANES included only a single 24-hour recall, yet snacking behavior can vary from day to day. Thus, snacking prevalence may have been under-estimated.*
- *The authors limited their analyses to subjects who did not have any missing data on any of the variables used. It is unclear how many cases were excluded for missing data; such exclusions may have led to biased estimates and the findings may not be truly representative of the US population.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	Yes
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	N/A

4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	No
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	No
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	N/A
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes

7.1.	Were primary and secondary endpoints described and relevant to the question?	N/A
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	N/A
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes